Center for Independent Experts Peer Review of sDPS Green Sturgeon Draft Recovery Plan Entitled:

Internal Draft Recovery Plan
Southern Distinct Population Segment
North American Green Sturgeon
(Acipenser medirostris)
Prepared by
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Executive Summary

This report comprises a review of the ***Internal Draft Recovery Plan Southern Distinct Population Segment North American Green Sturgeon (Acipenser medirostris)*** (the **Plan**) which was prepared by the National Marine Fisheries Service Southwest Regional Office Santa Rosa, CA, 2012. The **Plan** is a document which is intended as a "road map" for the recovery of the southern Distinct Population Segment (sDPS) of green sturgeon which spawns in the Sacramento River watershed and subsequently, and largely, rears in marine environments along coastal western North America after a short-natal freshwater-rearing period (*c.a.,* up to two years). The green sturgeon is a long-lived, obligatory-anadromous species and, for its brackish and marine phases, the sDPS is also found in three other macro-habitat units including the San Francisco Bay, Delta and Estuary (SFBDE), Coastal Bays and Estuaries (CBE), and Nearshore Marine (NM) from Mexico to Alaska. In 2006 the sDPS green sturgeon was listed as "threatened" under the United States *Endangered Species Act*, thus the legislative impetus for this **Plan**.

My opinion of the draft **Plan** is that it is very detailed and comprehensive in listing the many aspects relating to the potential or actual threats that sDPS green sturgeon face and the authors should be complimented for tackling such a difficult task. However, it is also my view that it would likely be difficult to attain recovery of sDPS *A. medirostis* based on the current draft of the **Plan**. This is, fundamentally, not a reflection of the amount of work that has gone into this **Plan**, or the intellectual processes and the abilities of its authors, but rather due to a lack of structural focus as to how the **Plan** has been written, and an inherent deficiency in baseline information. Also, it is difficult for me, as the reader, to understand who or which agencies have the roles and responsibilities in delivering the **Plan** for sDPS green sturgeon and where the funding will come from for what, I believe, will be a monumental task. These are not clearly laid out in this document, in my opinion.

In the context of the structure of the **Plan**, I think it needs considerable editorial streamlining. It is my view that the reader is so overwhelmed with the vast specter of possible *threats* that are presented in the document and in an onerously repetitive fashion amongst the four habitat units, that it is difficult to sort out which ones are likely to be absolutely critical to address, and which are not priorities (even though the **Plan** ranks the *threats* into *low*, *medium*, *high* and *very high*, and profiles the latter two).

Linked to this is the fact that so little is known about the biology of sDPS green sturgeon, relative to other species under these similar circumstances, that much of the presentation of the impact of the *threats* in the report is conjecture with little in the way of documentation, citations or referencing. To counteract the problem that so little of the sDPS green sturgeon life history is

known, the writers of the **Plan** seem to have tried to be totally inclusive in their deliberations of what might constitute a threat, thus the large list of possibilities incorporated into the document. In regards to the biological deficiencies, the first and foremost is that we clearly do not know how many sDPS green sturgeon there are. The authors of the document recognize this but I still think this has to be emphasized much more strongly; numerical stock assessment of these fish should be the frontispiece of the **Plan** and its recovery program. Secondly, understanding the spawning behavior and characterizing the reproductive habitats, as well describing the early life-history of these fish to the point of exit from San Francisco Bay to the marine environment, needs to be the core-research deliverable. These task need to be explicitly stated "front and center" in the **Plan**. The managers undertaking the recovery plan can then, more-clearly, provide the decision makers with recommendations in regards to recovery of this species.

I believe that the authors have put far too much speculation into the manuscript in regards to what might need to be addressed but with a dearth of hard documentation in regards to which threats that need to be dealt with immediately in order to provide recovery. That is, the writers seem to have "cast their nets far and wide" in order to be totally inclusive in the hope that they "get it right" but in the process leave the reader wondering what actually will be done, what can be done and what are the priorities. My suggestion is that the authors of the **Plan**, in a subsequent redraft, substantially consolidate and focus on threats that are clearly-likely to be most important (probably all of the *high* and *very high* Threats that the **Plan** currently has identified), and only make passing reference to the remainder, perhaps within an appendix.

An important omission, as well, is that the authors of the **Plan** have completely left out discussion around the use of conservation aquaculture as an option for recovery. While the current policies may preclude this as an option for a *threatened* species, it still needs to be discussed as a strategy including its pros and cons. The readers will want to know why it has been left out.

Finally, as an important consideration, the **Implementation Schedule and Cost Estimates** section, as recommended by the **NMFS Interim Recovery Planning Guidance** document, is missing from the main body of the **Plan,** and this information is only very-sketchily covered within Appendix F of the **Plan.** These details are critical for the implementation of the **Plan**.

Thus, my primary recommendation is that the authors sharpen their pencils and severely edit this into a much more focused document so that the public, bureaucrats and politicians can support the recovery of sDPS green sturgeon politically and monetarily, with information-gathering on stock status and early life-history being the top priorities.

1.0 Background

The green sturgeon (*Acipenser medirostis*) is an obligatory-anadromous member of the Order Acipenseriformes and the Family Acipenseridae (Moyle 2002). This taxon lives in the North Pacific and is comprised of two primary genetic units including Asian and North American populations; these bio-geographic units probably constitute separate species (Vasil'eva et al. 2009).

Within the eastern Pacific, there are a number of geographically discrete green sturgeon populations including those that spawn, and rear early in their life history, in the Rogue, Klamath and Sacramento watersheds. Under United States *Endangered Species Act* legislation, these green sturgeon groups include both an unique northern Distinct Population Segment (nDPS)—found in the Rogue and Kalamath river watersheds—and a southern Distinct Population Segment (sDPS)—in the Sacramento-San Joaquin river watershed; the latter stock is now designated as "*threatened*" (NMFS 2006) and is subject to a recovery actions by the United States and the focus of this document. The sDPS green sturgeon were known to spawn only in the mainstem Sacramento River (Beamesderfer et al. 2004, Poytress et al. 2012) but there is a recent discovery of reproducing fish in the Feather River which may mean there are other spawning populations (Seesholtz 2011; Van Eenenaam 2011).

Very young North American green sturgeon live in fresh water for a short-time period but become estuarine, or marine, early in their lives (<3 years) (Moyle 2002). Little, however, is known about this part of the sDPS green sturgeon in the Sacramento River watershed and the San Francisco Bay, Delta and Estuary. Coastal migrations of subadult and adult green sturgeon range from Mexico to Alaska (Moyle et al. 1995, Lindley et al. 2011) with sDPS green sturgeon being confirmed within this range.

As part of its mandate under the *Endangered Species Act*, the National Marine Fisheries Service (NMFS) of the United States of America has initiated recovery actions for the recovery of sDPS green sturgeon subsequent to its listing (NMPS 2006) and designation of critical habitats (NMFS 2009). Activities in these regards include the development of a recovery plan for this species and a document has currently been written entitled ***Internal Draft Recovery Plan Southern Distinct Population Segment North American Green Sturgeon (Acipenser medirostris)*** (the **Plan**). The **Plan** was prepared by the National Marine Fisheries Service, Southwest Regional Office Santa Rosa, CA, 2012, and is a document which is intended as a "road map" for the recovery of the southern Distinct Population Segment (sDPS) of green sturgeon.

As part of the development of the **Plan**, reviewers were selected by the Center for Independent Experts (CIE) to provide professional and editorial comments in respect to this internal draft of the **Plan**. This document that I have written provides such advice.

2.0 Description of the Reviewer's Role in the Review Activities

For this review I undertook a detailed edit and commentary of the written recovery **Plan** materials provided to me including the main body of the report entitled ***Internal Draft Recovery Plan Southern Distinct Population Segment North American Green Sturgeon (Acipenser medirostris)*** as well as the six attached appendices.

Additional to this, ancillary background material was sent to me including ***2006 (2010 Update) NMFS Interim Recovery Planning Guidance (***http://www.nmfs.noaa.gov/pr/pdfs/recovery/guidance.pdf***), Endangered Species Act (***http://www.nmfs.noaa.gov/pr/pdfs/laws/esa.pdf***)*** and Mora et al. (2009).

In order to get more familiar with the topic I also read some or all of the documents listed in the References section as well as a spectrum of reports and web sites relating to germane topics such as system operations of Sacramento River diversions, watershed dam operations and their locations, other species recovery plans, green sturgeon biology and fisheries management, Central Valley California water issues, etc.

My review comprised a number of components. Firstly, I followed the contractual directions of answering the seven questions posed to the reviewers. I also provided a number of Conclusions and Recommendations as required under the Terms of References.

Secondly, I undertook a detailed review of the **Plan** as well as the attached appendices. In order to convey my thoughts, my editorial review was embedded directly into the files for ease of transferring the information to the report writers. For this document, which was written in Microsoft Word, I used the editorial function whereby any of my revisions or comments were embedded, into the **Plan's** main report and within the attached appendices, with red font. For direct-editorial suggestions, I used normal lower and upper case font, while thoughts and comments were embedded into the relevant sections in red capitals bookended with square brackets.

3.0 Summary of Findings for each TOR Describing Weaknesses and Strengths of the Plan (7 questions asked of the reviewers)

3.1 Do the basic elements of the draft recovery plan meet the minimum standards for recovery plans outlined in the NMFS Interim Recovery Guidance and mandates described in section 4(f)(1)(B) of ESA? viz.:

4(f)(1) RECOVERY PLANS.—The Secretary shall develop and implement plans (hereinafter

in this subsection referred to as "recovery plans") for the conservation and survival of endangered species and threatened species listed pursuant to this section, unless he finds that such a plan will not promote the conservation of the species. The Secretary, in developing and implementing recovery plans, shall, to the maximum extent practicable—

(B) incorporate in each plan—

(i) a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;

(ii) objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list; and

(iii) estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal.

(i) *Site-specific management actions*—In my opinion the site-specific management actions, as articulated in the **Plan**, are lacking in sufficient detail to meet the mandate of Section (i) in the *ESA 4(f)(1)*. Specifically, for Appendix F the particulars for specific actions and projects, tied to objectives and recovery strategies, are largely limited. For example, it is difficult to know which agency or group will be the proponent of the program delivery outside of vague references in columns D and F in the RSO spread sheets and what they are going to do.

As an example, in RSO 1, for *Barriers to Migration / Optimize green sturgeon upstream and downstream passage / Impoundments / Minimize the impact of impoundments on adult and juvenile green sturgeon migration,* the *Responsible Parties* are *FERC, Corps, DWR, Water Diverters*. These agencies are so large and multifaceted that it would be impossible to determine who is going to do what and when from this spread sheet. And the dollars required to meet this, and other such actions are largely non-existent.

(ii) *Objective, measurable criteria*—In my opinion the **Plan** does not provide sufficiently objective or measureable criteria to meet the delisting objectives of the *ESA*. The stated objectives are very vague and as follows:

1. *Increase sDPS green sturgeon abundance, productivity, distribution, and genetic diversity to a level that will sustain a viable population with a low risk of extinction.*
2. *Conserve existing and restore and conserve historical, spawning, rearing, and/or migration habitat in the four defined geographic habitat units.*
3. *Ameliorate existing threats, as well as prevent future threats, to sDPS green sturgeon in the four geographic habitat units to the extent necessary to achieve objectives one and two.*

For the authors to develop clear, objective and quantitative objectives and measureable criteria are very difficult because little is known about the basic biology and the causal threats to sDPS green sturgeon. I point out that the writers of this document do not have a good grasp of the population(s) size of the sDPS green sturgeon as there has never been an adequate stock enumeration. Likewise, they have little understanding as to what the historical size likely was. The "best guess" estimate presented in the **Plan** is between 5,000 -10,000 sub-adults and adults with two different estimates of adult spawners, per year, of 10-28 and 175-250 individuals (i.e., an order of magnitude difference).

Inventory and assessment in respect to the basic early life history of this species is also largely missing for the sDPS green sturgeon not only within its total range but the key freshwater / estuarine period, the Sacramento River watershed and the San Francisco Bay, Delta and Estuary. Thus it is difficult for the individuals or agencies tasked with writing this recovery **Plan** to come up with objective and measurable criteria when a basic biological understanding is missing. And because so little is known about the number of fish and basic biology, the presentation of *threats* is largely conjecture although stream flows and physical habitat in the Sacramento River must be at the top of the list.

(iii) *Estimates of the time required and the cost*—Again, it is my opinion that the costing and timelines are very weakly developed to non-existent. This does not mean that they have not been recognized by the authors, and some thought put into this aspect of the deliverables. However, within the spreadsheet matrix (Appendix F), the actions are generally vague in terms of actual activities, and who the working party will be, and as a result the amounts of money needed and timelines are generally missing (usually columns H and greater in the Appendix F RSO spreadsheets are blank) from the analysis.

My conclusion is that based on the lack of clarity in regards to the (1) baseline biology of sDPS green sturgeon and causal threats, (2) roles and responsibilities, (3) money and capacity and timelines, (4) explicit execution of any of the proposed recovery programs and (5) the vague biological end-points in respect to removing this species from the *Endangered Species Act* listing, it is my view that the **Plan** does not meet the minimum standards required under 4(f)(1)(B) of the *Act.*

3.2. Is there a logical and consistent flow between the goal, objectives, criteria, and actions?

Goal

It is my opinion that the Goal contained within the **Plan** is appropriate viz. *Recovery will be achieved when the ecosystems upon which this species depends are restored to conditions that*

allow a healthy, self-sustaining, viable population of sDPS green sturgeon to persist in the wild within their historical range.

Objectives

Objectives should be a restatement of the Goal using measurable end points. This becomes problematic for these fish insofar as so little is known about sDPS green sturgeon and its threats, thus, concrete and measureable values are difficult to achieve. While the three-stated objectives are correct in regards to measureable-end points, detail in respect to numerical quanta regarding sturgeon abundance targets, and understanding which threats are likely to be resolved, would be helpful:

1. *Increase sDPS green sturgeon abundance, productivity, distribution, and genetic diversity to a level that will sustain a viable population with a low risk of extinction.*

2. *Conserve existing, and restore and conserve historical, spawning, rearing, and/or migration habitat in the four geographic habitat units.*

3. *Ameliorate existing threats, as well as prevent future threats, to sDPS green sturgeon in the four geographic habitat units to the extent necessary to achieve objectives one and two.*

Actions

In regards to the Goal and Objectives, I think that the **Plan** first needs to understand the basic biology of sDPS green sturgeon, and then figure what the threats are, and how they are threats, before moving on. These points are articulated in the *Plan* as per the bulleted-excerpt below. My view is that these items are not strongly-enough emphasized in the Objectives or the subsequent Actions although they are certainly mentioned.

- *Develop a comprehensive research plan to provide data to finalize demographic and threat-based recovery criteria, as well as guide recovery actions.*

- *Develop a monitoring plan to demonstrate attainment of interim and final demographic and threat-based recovery criteria, and track the effectiveness of recovery actions.*

- *Develop an education and outreach program to gain support from stakeholders to facilitate implementation of this recovery plan.*

- *Work with partners to secure a stream of funding for developing and initiating this recovery plan, including the development and implementation of research, monitoring, and outreach programs.*

These are the two great weaknesses both in recovery of sDPS green sturgeon and the Plan itself—not understanding how many sDPS green sturgeon there are and which and how current threats are causing it to be in a state of vulnerability to extinction. As an example, Objective Statement 2: "*Conserve existing, and restore and conserve historical, spawning, rearing, and/or migration habitat in the four geographic habitat units."* may largely be irrelevant to the **Plan** if there is a really only a single issue that can easily be resolved that allows sDPS green sturgeon to recover to a sustainable level (e.g., perhaps tweaking flows on the Sacramento in June-July to increase survival of larvae and fry).

3.3 Does the plan incorporate the best scientific information available?

In my opinion the **Plan** incorporates much of the scientific information available for sDPS green sturgeon and is comprehensive in respect to the current knowledge of the species, generally, and this particular Distinct Population Segment. Countering this, however, is a general dearth of biological information on this distinct population segment. In other words, the authors got most or all of the science incorporated into **Plan** but, unfortunately, our understanding of this species is limited in respect to providing guidance for recovery actions.

The amount of science available for sDPS much of the key-required information to undertake recovery of sDPS green sturgeon is largely not been gathered or is very weak; this gap is recognized and discussed in the **Plan**. Furthermore, the linkage between putative *threats* and the stock declines are very poor as the two are directly linked to baseline science. It is my view that, because of this, the authors tried to be all-inclusive in the their umbrella approach of incorporating everything that might have an influence on the decline of sDPS green sturgeon and have, thusly, made their document very unwieldy to read. Evidence of this is summarized in the Table 1 below. Out of 393 threats over the four habitat units, only 13% were considered to be *high* or *very high*. Of these, only 1% had information sufficiency that would be considered *high* or *very high*. In contrast, almost 90% of the threats presented were of *medium* or *low* character and even these had very poor data sufficiency with only 1.5% being *high* or *very high*. In short, not only have the authors of the Plan included a large amount of material that is probably largely superfluous under the triage situation we find sDPS green sturgeon in, the information that is available is mostly very poor, even for the highest *threat* categories.

I would, additionally, suggest that the authors might want to strengthen the **Plan** by incorporating more data (hydrographs) on Sacramento River watershed flow regimes and, in doing so, provide a clearer understanding of system operations of dams, diversions, pumping stations in respect to sDPS green sturgeon.

Table 1—Analysis of threat rating and data availability for all threats.

Appendix E Summary of Threats Results Tables

	Threats High or Very High	Data Sufficiency High or Very High	Threats Medium or Low	Data Sufficiency High or Very High
Sacramento River	17	1	172	0
San Francisco Bay, Delta, Estuary	12	0	76	5
Coastal Bays and Estuaries	13	1	56	1
Nearshore Marine	6	0	41	0
Totals = 393 threats	**48**	**2**	**345**	**6**
Note: grey boxes comprise 26 threats	48 out of 393	4 out of 393	345 out of 393	6 out of 393
	12%	1%	88%	1.5%

As a final thought, one important and critical science-based omission within the **Plan** is that of conservation fish culture. This strategy has been used extensively for white sturgeon on the Nechako, Kootenai and Columbia rivers, and elsewhere around the world for other species. Conservation fish culture is a controversial strategy for recovering threatened and endangered fish stocks and species as it is being practiced in North America and around the world. My view is that it is not appropriate, at this time, to engage in conservation-fish culture for sDPS green sturgeon at this time; the numbers of fish are currently robust enough to survive any immediate threat. However, because there has been already been considerable discussion in respect to whether it should be listed, under the *ESA*, as *endangered*, and the actual numbers and trending are not well understood and the only known regularly-spawning population is confined to one stretch of a single river, it needs to be considered as a last-gasp back-stop measure. Thus, I think there needs to be discussion around this strategy and the science associated with it, as well as the pros and cons of engaging in conservation fish culture for a species such at sDPS green sturgeon within the **Plan**. Again, the consensus will likely be that it is not appropriate at this time but, given the time frame involved in recovery and the large-scale unknowns regarding these fish, dialogue needs to be started now.

3.4 Does the plan address data gaps appropriately in relation to the formulation of recovery criteria and research actions (e.g. lack of information on contaminants to develop threats-based recovery criteria)?

While the **Plan** recognizes the data gaps associated with the extensive lack of knowledge in regards to sDPS green sturgeon, it is my opinion that it does not emphasize, strongly enough, the research needed to address the *threatened* status of these fish. For example, for the *NMFS Interim Recovery Planning Guidance* document recommendation, the *5.5.10 Implementation Schedule and Cost Estimate* section is missing in the **Plan**. My view is that this section should

have been including in regards to providing detailed communication to the reader the why, when and how particular aspects of research program should be undertaken. Again, to reiterate, in my opinion the two key immediate research needs are: 1. undertake a rigorous mark-recapture program in order to understand the stock status, and 2. examine the early freshwater life-history in the Sacramento River.

In lieu of the missing implementation and costing section in the **Plan**, the authors have included Appendix F which, unfortunately, is incomplete in these regards. Much of the details surrounding the objective and actions, as well as prioritization, time frames, delivery agencies/groups and costs are missing. These are significant gaps and need to be rectified. Key to this is the section tied to research in RSO 5 (see spreadsheet excerpt below).

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Develop a comprehensive sDPS green sturgeon research plan to provide information to adequately assess population viability parameters, as well as fill data gaps in our understanding of the impacts of threats.**												
2	**Recovery Action Number**	**Category**	**Objective**	**Action Step**	**Priority Number**	**Action Duration**	**Responsible Parties**	**Estimated Fiscal Year Costs $ K**					**Comments**
3								**FY1**	**FY2**	**FY3**	**FY4**	**FY5**	
4	**RP.1**	**Demographic Recovery Criteria**											
5	**RP.1.1**		Conduct research to refine demographic criteria										
6	**RP.1.1.1**			Conduct research to refine Distribution criteria by assessing the quality and quantity of spawning habitat below Shasta Dam		5							
7	**RP.1.1.2**			Conduct research to refine Distribution Criteria by assessing habitat potential in rivers currently not occupied by green sturgeon (list									
8	**RP.1.1.3**			Conduct research to refine Productivity and Abundance Criteria by supporting research programs that support and validate the development of a conceptual life history model.									
9	**RP.1.1.4**			Conduct research to refine Productivity Criteria to determine the preferred rearing and holding habitat utilized by wild juvenile green sturgeon. http://wdfw.wa.gov/publications/00110/wdfw00110.pdf									
10	**RP.1.1.5**			Conduct research to further refine Diversity criteria by characterizing: 1) genetic diversity in the adult and subadult population of sDPS green sturgeon in San Pablo Bay and, 2) genetic diversity in the spawning adult population of sDPS green sturgeon in the									
11	**RP.1.1.6**			Support research programs that support and validate the development of a conceptual life history model.									
12	**RP.2**	**Threats-based Recovery Criteria**											
13	**RP.2.1**		Conduct research to refine threats-based recovery criteria										
14	**RP.2.1.1**			Conduct research to develop Listing Factor A: Contaminant Criteria – to determine which pesticides and fertilizers, or their combination, could adversely affect green sturgeon. In addition, both pesticide and fertilizer application methods should also be studied to determine best management practices to help educate agricultural									
15	**RP.2.1.2**			Conduct research to develop Listing Factor A: Sediment Criteria – to determine sediment criteria for suitable spawning and foraging									
16	**RP.2.1.3**			Conduct research to develop Listing Factor A: Temperature Criteria – to evaluate water temperatures in the lower Yuba River (tributary to the Sacramento). Assess whether the reported suitable ranges for embryo incubation (7.78 to 17.2 degrees C) are accurate.									
17	**RP.2.1.4**			Conduct research to refine Listing Factor C: Predation – to determine the native and non-native predator-prey relationship and how it is affecting green sturgeon juveniles and adults									

3.5 Does the data provided by Mora et al. (2009) provide NMFS the best means for evaluating current and future habitat potential and the development of criteria to restore historical green sturgeon habitat within California's Central Valley.

My view of the Mora et al. (2009) paper is that it is an exceptional document investigating the habitat utilization of spawning sturgeon. This combined with Poytress *et al*. (2011) helps elucidate what is required by the reproducing adults. Similarly, Lindley et al. (2008) helps fill in the gaps in respect to the marine environment for these larger and older fish; thus, these three papers provide key information in respect to the adult and sub-adult phases.

However, my main concern is that spawning habitats, and their current characteristics in the Sacramento/San Joaquin drainage, may not be the primary limiting factor(s) for production. Indeed the period of early life history may be far more critical to production than the actual

act of spawning and its flow/habitat requirements. Key to this statement is the following quote from the Mora et al. (2009) paper, which reads:

> *Finally, our model dealt only with mature green sturgeon. Other life stages, especially larvae and juveniles, may use very different habitats, and these habitats may have been altered more by the effects of dams and flow regulation than the spawning, holding and migratory corridor habitats that our model addresses. Unfortunately, very little information is available on the habitat requirements and utilization patterns for these early life stages. While expensive and logistically challenging, much work is needed to further advance our understanding of the habitat requirements and potential distribution of green sturgeon.*

My concerned perspective comes from the issues surrounding white sturgeon flows and spawning/early rearing in the Kootenai and Nechako rivers. Populations of white sturgeon in the Kootenai and Nechako rivers have profoundly collapsed since the diversion of waters/change in flow regimes due to dams upstream of historical reproductive habitats. While both populations are now no longer reproducing naturally, recent experimental changes in flows in the Kootenai, back to more "normal" spawning-discharges, do not seem to have resulted in recovering white sturgeon even though the adults are known to spawn in this stream year after year. However, the floodplain of the Kootenai River downstream of known spawning area has been profoundly altered since the construction of Libby Dam (channelization, diking) and the early-life-history-rearing habitats may no longer have the capacity they once did.

Thus, spawning flows may not be the key drivers in regards to maintaining or recovering sDPS green sturgeon. Mora et al. (2009) indicate that late spring and summer flows are the most profoundly affected in the Sacramento/San Joaquin drainage and this may be the time period when the newly-hatched larvae and fry may be at their most vulnerable. Indeed, given the large fecundity of green sturgeon it is almost certain this is a likely-critical period (and maybe the most critical). One needs to understand, as well, that there have been large-scale changes to the landscape/riparian areas of the lower Sacramento River watershed downstream of these major dams. This is, presumably, key young sDPS green sturgeon habitats. Thus, the altered-early-rearing flows as well as changes in the channel-characteristics and floodplain/riparian areas to the lower Sacramento River, for the larvae and fry, may actually be of more concern for the maintenance and recovery of sDPS green sturgeon than the spawning environments in this watershed.

3.6 Does the plan provide clear guidance for the public, conservationists, managers, regulators, and others to act in a relevant manner over the next several decades to facilitate recovery of sDPS green sturgeon?

In my opinion, the **Plan** falls short of being able to provide clear guidance to the public, conservationists, managers, regulators, and others. This is largely because of the vagueness of the **Plan.** Again, the basic biology of the sDPS green sturgeon including stock size, an unclear

understanding of the relationship between threats and putative declines in the fish, a lack of clear roles and responsibilities in regards to the recovery deliverables, and lack of funding and timelines.

3.7 Recommendations for improvements?

Strategic direction of the **Plan**

1. It is my view that the **Plan** represents a triage situation for sDPS green sturgeon. From that perspective, the authors of the **Plan** need to focus on the most critical aspects of potential and likely **threats**. This suggestion is meant to be practical insofar as capacity and monetary resources are likely to be limited and I think the focus of this document must be to these key aspects. I point out that almost 90% of the almost 400 listed threats are only *medium* or *low*. I believe that the authors should, in the main body of the Plan, address threats that are *high* or *very high* with the remainder limited to a summary presentation in an Appendix at this time.

2. Understanding what the population number of sDPS green sturgeon is, is critical in my view. Undertaking a comprehensive mark-recapture program to determine this value should be front and center of the **Plan**.

3. I think that the subsequent priority focus of the **Plan** needs to be towards understanding the early-life history in freshwater (i.e., the Sacramento River) with the San Francisco Bay, Delta and Estuary following closely behind. Flows and discharge characteristics need to be key research topics. While the first big causes of sturgeon collapses, over numerous species and around the world, were due to overharvest, the secondary causes are related to freshwater habitat impacts, primarily flow changes and blockage of migratory routes. I would suggest the habitat research be undertaken in the Sacramento River, at the spawning locations, and then work downstream through to the San Francisco Bay, Delta and Estuary, as funds allow with flow management in the Sacramento River being the most obvious concern. At this time, I think that the some of the key threats to habitat will, as a matter of course, become self-evident.

4. The data gaps within the **Plan,** in terms of delivery and costing, are substantial and critical. Appendix F—*Implementation Schedule* has large amounts of information missing in terms of program-delivery roles and responsibilities, costing and time lines. In particular, the components within the sheet *RSO 5 – Develop a comprehensive sDPS green sturgeon research plan to provide information to adequately assess population viability parameters, as well as fill data gaps in our understanding of the impacts of threats* is critical to address.

5. Figuring out funding and roles and responsibilities should be very high priorities within the **Plan** structure, perhaps even before undertaking a stock assessment (i.e., figuring out how many fish there are). If you have no money, and you don't know who is going to do the work, recovery will not take place for this species.

6. The issue of an **Interim Plan** needs to be fleshed-out more thoroughly. Given the unknowns and the long-lived life-history of green sturgeon, I believe that the recovery program for sDPS green sturgeon will, ultimately, require some sort of an **Interim Plan** phase that may be for a considerable number of years (5-10) before a **Final Plan** is written and implemented.

7. The issue of conservation fish culture for recovery of sDPS green sturgeon needs to be discussed in the **Plan**. It is unlikely to be appropriate to engage in such a strategy, at this time if ever, but the dialogue surrounding it needs to be dealt with at this point. I am not a proponent of conservation fish culture as, in my opinion, it reduces the impetus to do the correct thing in the natural environment. However, if it becomes the last resort to conservation, then it should be done properly. And the agencies better figure out long in advance what to do and how to do it if it comes down to using hatcheries to stave off extinction. As an additional thought, the issue of fish culture of sturgeon, via escapees also needs to be discussed if it looks like green sturgeon will ever be cultured in North America (which it probably won't).

Structure of the **Plan**

1. I question the need for inclusiveness of the **threats** that are medium and low within the main body of the **Plan**. It is my opinion that these threats should be relegated to an appendix.

2. In my opinion the **Plan** (including appendices) suffers from extensive repetitiveness. While the intention of the authors appears to be a desire to be comprehensive in nature, what happens is that the important information is lost to the reader. As an example, non-point-sources pollution is repeated numerous times across the various habitat categories and one easily loses track of which is important and which isn't. It seems to me that consolidating some of these instances where the threats are repetitive would make the **Plan** far more readable and "punchy" but not impact the comprehensiveness of the document.

3. The Executive Summary needs to be shortened substantially. The NMFS guidelines for recovery plans make is clear that this is to be one page only.

4. A comprehensive glossary needs to incorporated into the front of the document. This needs to include not only acronyms, of which the current document partially does now, but specific terms used in the document. To give an example, the word "threat", where used in a legal or formal sense, needs to be defined. I say this in recognition that Appendix A is a section of definitions. Still, there needs to be some level of explanation for the many complex, scientific and bureaucratic terms that the reader is faced with.

5. Throughout the document specific terms like "threat" have a specific meaning to the document that relates to recovery planning. I think terms like this should be capitalized and/or emboldened and/or italicized, etc. (i.e., Threat, **threat**, threat, *threat*, ***Threat***). The use of a font that offsets these kinds of words or terms from the rest of the text would make reading the document much easier.

6. Heading prefaces such as "SRW.D.1.1.1" are very complicated to follow from the perspective that there is so much detail that it is easy to forget what SRW means. I would suggest if that the letters were spelled out it would make it a lot easier for the reader. And, perhaps, the basic outline could be streamlined so that there are not so many sub-points within a given topic.

7. The authors need to provide good maps when they talk about specific places. There are a few maps but the scale is far too small for some of the locations that the **Plan** discusses.

8. The **Plan** needs to incorporate a List of Tables and a List of Figures.

9. Because of the critical aspect of flows and sturgeon spawning and incubation, there needs to be more emphasis on water allocation and flow re-arrangement in the Sacramento watershed, including both downstream of dams as well as the system operations of those impoundments. Hydrographs and figures detailing some of the diversions within the Sacramento River watershed would help the readability.

10. There are large numbers of statements made throughout the document that need documentation (citations, references, pers. com., etc). This needs to be rectified. I try to articulate these omissions in my editorial comments embedded into the document.

11. While it may not be the role of this document to ask why the listing is not Threatened rather than Endangered, it seems to me that, within the dialogue of the **Plan**, there needs to be a cognizance that this is a very real possibility of happening, given the small size of the sDPS population(s), within the proposed recovery period. I point this out as the information relating to stock abundance, spawning locations, critical habitat, etc, while growing, is still quite scarce for a fish that might require large capital costs (e.g., diversion removal, more water for fish but less for crops) to initiate recovery.

12. For threats I would only have three, including : *Listing Factor A - Habitat Destruction, Modification; Listing Factor B - Overutilization for Recreational, Commercial, Scientific, or Educational Purposes; Listing Factor C - Disease and Predation*. I would incorporate the last two into the first three, including: *Listing Factor D – Inadequacy of Existing Regulatory Mechanisms; Listing Factor E - Other Natural or Man-made Factors*.

13. Terms such as egg, embryo, larvae, fry, fingerling, sub-adult, adult need to be defined in this document in regards to the various life stages of green sturgeon. You may not use some of these, or add some. Or you may disagree with my list. But they should be identified in a table embedded within the body of the text, or in the Glossary.

14. I think there is a need to explain why the document used the Miradi model. I do not really understand it, but I think it warrants some discussion.

15. The document refers to "*take*" as catch, both historical and directed, and current and by-catch. It is also used in regards to other sources of anthropogenic mortality. I do not like this word in the context that you use it but it seems to be a legal ESA term. I would suggest that the document sub-head the term *take* with "fishing mortality", "by-catch mortality", pump-entrainment mortality", etc.

4 Conclusions

While this is an excellent start to the recovery planning of sDPS green sturgeon, the authors of the Plan need to undertake extended editorial work to streamline the document into a work that focuses on the triage aspect of green sturgeon. I do not think that the recovery of sDPS can proceed under the directions provided by the Plan as it is now written, but it is a solid document with which to focus on providing a report that is workable. Added to this, however, is the need to write and implement an **Interim Plan**. I suggest that this is more critical at this stage of sDPS green sturgeon recovery.

5 Recommendations

1. An **Interim Plan** for sDPS green sturgeon needs to be written and implemented with the priorities, as suggested in this review, first-in-line (population estimation and freshwater habitat life-history research being undertaken).

2. There has to be the securing of funds and political/managerial support to achieve the objectives of sDPS green sturgeon recovery. It is not clear if this should happen prior-to

or after the development of an Interim Plan, but it is likely that such efforts to obtain capacity will be ongoing for many years.

3. The **Plan** needs to be re-written and then implemented.

6 References

Beamesderfer, R., M. Simpson, G. Kopp, J. Inman, A. Fuller, and D. Demko. 2004. Historical and current information on green sturgeon occurrence in the Sacramento and San Joaquin Rivers and tributaries. S.P. Cramer and Associates, Inc. 46 p.

Lindley, S.T., M.L. Moser, D.L. Erickson, M. Belchik, D.W. Welch, E. Rechisky, J.T. Kelly, J. Heublein, and A.P. Klimley. 2008. Marine migration of North American green sturgeon. Trans. Am. Fish. Soc. 137:182-194.

Lindley, S.T., D.L. Erickson, M.L. Moser, G. Williams, O.P. Langness, B.W. McCovey, M. Belchik, D. Vogel, W. Pinnix, J.T. Kelly, J.C. Heublein, and A.P. Klimley. 2011. Electronic tagging of green sturgeon reveals population structure and movement among estuaries. Trans. Am. Fish. Soc. 140:108-122.

Moyle, P.B., R.M. Yoshiyama, J.E. Williams, and E.D. Wikramanayake. 1995. Fish Species of Special Concern in California. Second edition. Final report to CA Department of Fish and Game, contract 2128IF.

Moyle, P.B. 2002. Inland Fishes of California. University of California Press, Berkeley, California. p.p. 106-113.

NMFS (National Marine Fisheries Service). 2006. http://www.nmfs.noaa.gov/pr/pdfs/fr/fr71-17757.pdf

NMFS (National Marine Fisheries Service). 2009. http://www.nmfs.noaa.gov/pr/pdfs/fr/fr74-52300.pdf

Poytress, W.R., J.J. Gruber, and J.P. Van Eenennaam. 2012. 2011 Upper Sacramento River Green Sturgeon spawning habitat and larval migration surveys. Annual Report of U.S. Fish and Wildlife Service to U.S. Bureau of Reclamation, Red Bluff, CA.

Seesholtz, A. 2011. Lower Feather River sturgeon information, compiled in July 2011. Department of Water Resources, Division of Environmental Services. 4 p.

U.S. Fish and Wildlife Service. 1995. Age and growth of Klamath River green sturgeon (Acipenser medirostris). Klamath River Fishery Resource Office, Yreka, California. 20 p.

Van Eenenaam, J. 2011. Summary of egg verification by U.C. Davis Animal Sciences Feather River green sturgeon eggs collected from egg mats during 2011, Research Associate document, U.C. Davis Animal Sciences. 2 p.

Vasil'eva, E.D., V.P. Vasil'ev, S.V. Shedko, and G.V. Novomodny. 2009. http://www.researchgate.net/publication/225160271_The_validation_of_specific_status_of_the_sakhalin_sturgeon_Acipenser_mikadoi_(Acipenseridae)_in_the_light_of_recent_genetic_and_morphological_data

Appendix 1: Bibliography of Materials Provided for Review

2006 (2010 Update) NMFS Interim Recovery Planning Guidance (http://www.nmfs.noaa.gov/pr/pdfs/recovery/guidance.pdf)

Endangered Species Act (http://www.nmfs.noaa.gov/pr/pdfs/laws/esa.pdf)

Mora, E.A., S.T. Lindley, D.L. Erickson, and A.P. Klimley. 2009. Do impassable dams and flow regulation constrain the distribution of green sturgeon in the Sacramento River, California? Applied Ichthyology 25:39-47.

Appendix 2: Copy of the CIE Statement of Work

External Independent Peer Review by the Center for Independent Experts

Review of Draft Green Sturgeon Recovery Plan

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Representative (COR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: The Endangered Species Act (ESA) requires that NOAA's National Marine Fisheries Service (NMFS) develop and implement recovery plans for the conservation of threatened and endangered species. The southern Distinct Population Segment of North American green sturgeon was listed as a threatened species in 2006. It is a wide-ranging species, spawning in the Sacramento River in Central California, but spending the majority of its life in nearshore marine waters along the west coast of North America. Recovery plans serve as guidelines for achieving recovery goals by describing the steps that must be taken to improve the status of species and their habitat. Although recovery plans themselves are not regulatory documents, their primary purpose is to provide a conservation "road map" for federal and state agencies, local governments, non-governmental entities, private businesses, and stakeholders. The NMFS Recovery Plan for green sturgeon is expected to generate substantial interest from outside parties because it may contain recommendations involving water management in California's Central Valley. The draft recovery plan will include a large geographic area along the west coast of North America, with much of the focus on California's Central Valley, thus has the potential for wide-ranging implications. Stakeholder interest likely will lead to inquiries from elected representatives at the state and federal levels. The scope of work should focus on the principal elements required in a recovery plan. These principal elements have been defined in section 4(f)(1) of the federal Endangered Species Act (ESA) and sections 1.1 and 1.2 of the National Marine Fisheries Service Interim Recovery Planning Guidance (NMFS 2006). The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. CIE reviewers shall have

working knowledge and recent experience in the application of fisheries management, conservation biology, restoration practices, water management, and conservation under the ESA. Each CIE reviewer's duties shall not exceed a maximum of 10 days to complete all work tasks of the peer review described herein.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review as a desk review, therefore no travel is required.

Statement of Tasks: Each CIE reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the COR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, and other pertinent information. Any changes to the SoW or ToRs must be made through the COR prior to the commencement of the peer review.

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

In additional to the recovery plan report, the NMFS Project Contact will make available background materials to the reviewers for the scope and context of the review. Some of these background documents include;

- o 2006 (2010 Update) NMFS Interim Recovery Planning Guidance (http://www.nmfs.noaa.gov/pr/pdfs/recovery/guidance.pdf)
- o Endangered Species Act (http://www.nmfs.noaa.gov/pr/pdfs/laws/esa.pdf)
- o Mora, E.A., S.T. Lindley, D.L. Erickson, and A.P. Klimley. 2009. Do impassable dams and flow regulation constrain the distribution of green sturgeon in the Sacramento River, California? Applied Ichthyology 25:39-47.

Desk Review: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COR and CIE Lead Coordinator.** The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Conduct an independent peer review in accordance with the ToRs (**Annex 2**).
3) No later than ***November 5, 2012***, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator David Die via email to ddie@rsmas.miami.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

October 1, 2012	CIE sends reviewer contact information to the COR, who then sends this to the NMFS Project Contact
October 15, 2012	NMFS Project Contact sends the CIE Reviewers the draft plan and background documents
October 16-31, 2012	Each reviewer conducts an independent peer review as a desk review.
November 5, 2012	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
November 20, 2012	CIE submits the CIE independent peer review reports to the COR
November 27, 2012	The COR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COR within 10 working days after receipt of all required information of the decision on substitutions. The COR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of

the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:

(1) each CIE report shall completed with the format and content in accordance with **Annex 1**,
(2) each CIE report shall address each ToR as specified in **Annex 2**,
(3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COT, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COT. The COR will distribute the CIE reports to the NMFS Project Contact and Center Director.

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Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.

3. The reviewer report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work

Annex 2: Terms of Reference (ToRs)
CIE Peer Review of Green Sturgeon Draft Recovery Plan

The scope of work should focus on the principal elements required in a recovery plan. These principal elements have been defined in section 4(f)(1) of the federal Endangered Species Act (ESA) and sections 1.1 and 1.2 of the National Marine Fisheries Service Interim Recovery Planning Guidance (NMFS 2006).

Section 4(f)(1)(b) of ESA states "each plan must include, to the maximum extent practicable:

- a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;
- objective, measurable criteria which, when met, would result in a determination…that the species be removed from the list; and,
- estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal."

From section 1.1 of NMFS (2006), a recovery plan should:

- "Delineate those aspects of the species' biology, life history, and threats that are pertinent to its endangerment and recovery;
- Outline and justify a strategy to achieve recovery;
- Identify the actions necessary to achieve recovery of the species; and
- Identify goals and criteria by which to measure the species' achievement of recovery."

The terms of reference (ToRs) for this peer review:

1. Do the basic elements of the draft recovery plan meet the minimum standards for recovery plans outlined in the NMFS Interim Recovery Guidance and mandates described in section 4(f)(1)(b) of ESA?

2. Is there a logical and consistent flow between the goal, objectives, criteria, and actions?

3. Does the plan incorporate the best scientific information available?

4. Does the plan address data gaps appropriately in relation to the formulation of recovery criteria and research actions (e.g. lack of information on contaminants to develop threats-based recovery criteria)?

5. Does the data provided by Mora et al. 2009 provide NMFS the best means for evaluating current and future habitat potential and the development of criteria to restore historical green sturgeon habitat within California's Central Valley.

6. Does the plan provide clear guidance for the public, conservationists, managers, regulators, and others to act in a relevant manner over the next several decades to facilitate recovery of sDPS green sturgeon?

7. Recommendations for improvements?